Space Weather Technical Forecast

Issued on Tuesday, 28 March 2023 at 00:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1 Minor radio blackouts. Active electron fluence Likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional minor C-Class flares recorded at GOES16, the largest being a C4.6 flare at 27/0636 UTC. There are currently eight numbered sunspot regions on the visible disc. AR3256 remains the only magnetically complex region on the disc, with all other regions relatively small, stable and magnetically simple. No Earth-directed CMEs were observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by ACE, showed Earth transiting out of the negative polarity High Speed Stream from CH86/-, with the phi angle accordingly negative (towards the Sun) throughout. The solar wind has shown a steady downward trend due to the waning effects of HSS/CH86/-, starting the period at elevated levels, around 600km/s, declining to slow-ambient levels, near 380km/s at present. Density was near or below average. The IMF (Bt) was weak, near 7nT, throughout the period, with the all important north-south component (Bz) was also weak, varying between +4/-5nT. The net result of the above solar wind measures was for mostly Quiet (Kp 0-1) geomagnetic activity.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 remained at Background levels.

The high energy electron flux (greater than 2MeV) measured at GOES16 started at Moderate levels then rose to generally High from 27/0230 UTC, with a peak of 1570 pfu observed at 27/2100 UTC. The associated 24-hour fluence remained below the Active (1e8 integrated pfu) threshold, with a continued rising trend. At 28/0001 UTC the observed fluence was 2.48e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to remain Low, but with a Chance of becoming Moderate with any isolated M-class flares. The main region likely to give such flares is AR3256 in the southwest.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. Solar winds are expected to remain at slow-ambient levels after the recent HSS/CH86/-. The next coronal hole expected to impact Earth is CH88/-, possibly arriving late on day 3 (30th) with the effects continuing into day 4 (31st). Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected through the period. Later on day 3 (30th) and into day 4 (31st), if we see the CIR from CH88/-, geomagnetic activity may increase to Unsettled with Active intervals and a slight chance of G1/Minor geomagnetic storms.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to remain at Background levels, but with a Slight Chance of reaching S1 or greater,

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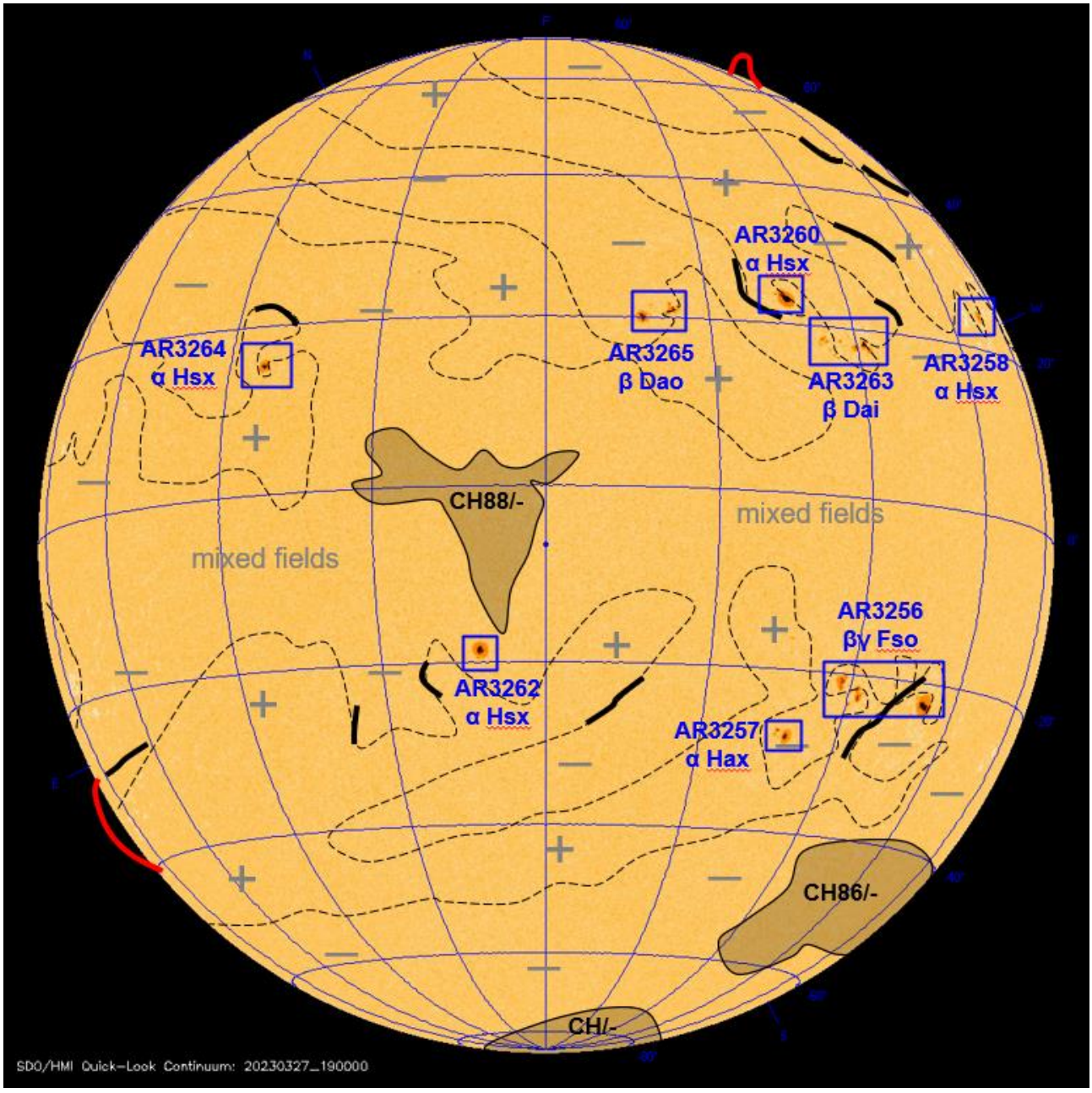
should any significant flares occur.

The high energy (greater than 2 MeV) electron flux is currently High and is likely to rise further, probably breaching the 1000pfu High threshold at times each day through the period. The associated 24-hour fluence is expected to continue on an upward trajectory, with Active (1e8 integrated pfu) conditions likely days 1 and 2 (28th/29th), probably easing by days 3 and 4, with the arrival of the next HSS from CH88/-.

Figure 1. Solar Analysis Valid 27/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

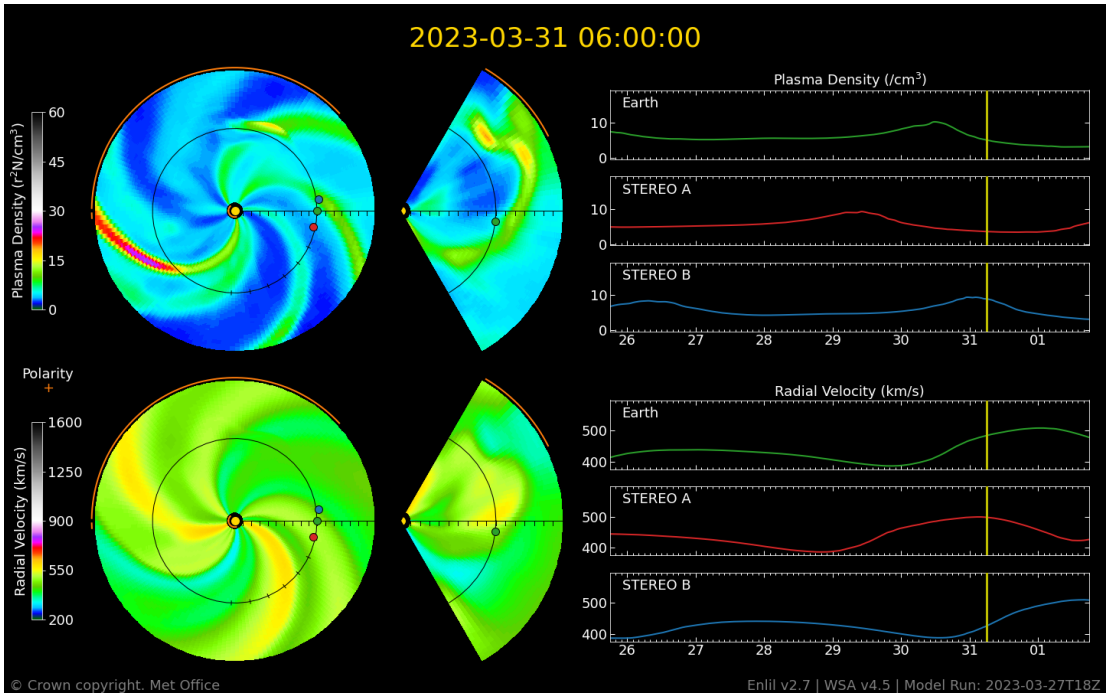
No Earth-directed CMEs feature in the forecast.

The recent fast wind enhancement from CH86/- is expected to continue to wane, with solar winds currently back to slow-ambient levels, which are expected to remain at this level during the next few days. The next coronal hole expected to impact Earth is CH88/-. This appears slightly further west than the previous rotation so it's possible we may see its HSS and possibly CIR late on day 3 (30th), before entering into the HSS on day 4 (31st), with speeds likely to reach up to 500-550km/s.

Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected through the period. Later on day 3 (30th) and into day 4 (31st), if we see the CIR from CH88/-, geomagnetic activity is likely to increase to Unsettled with Active intervals and a Chance of G1/Minor geomagnetic storms.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	30	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL – shows arrival of next HSS from CH88 around 30th or 31st March.



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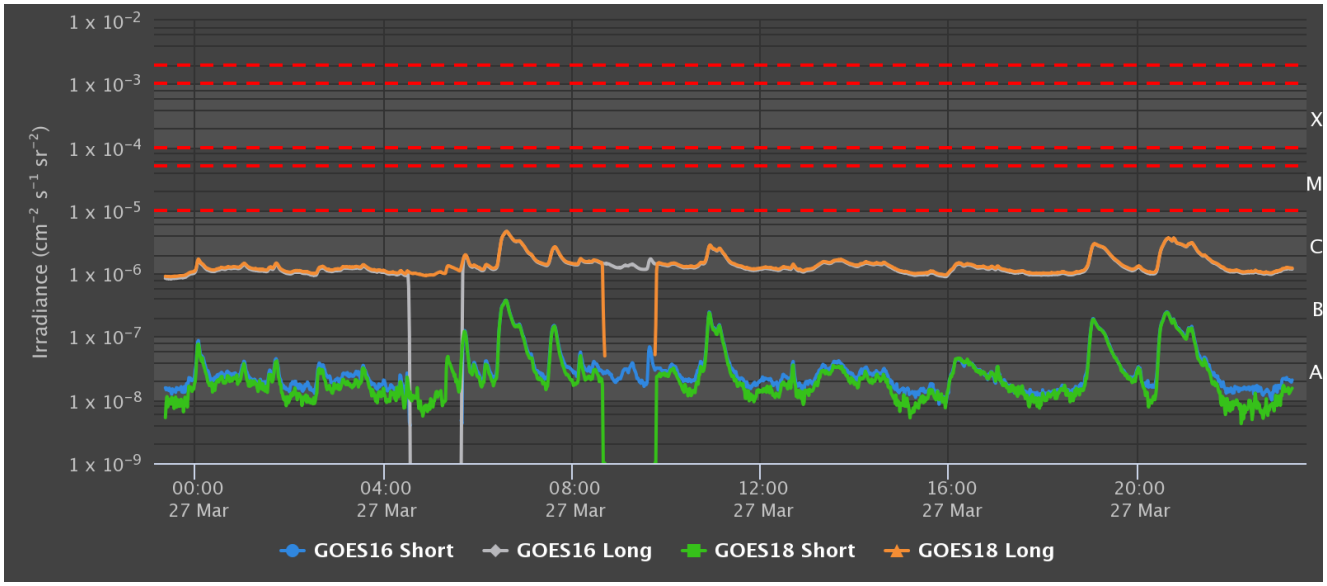
Radio Blackouts - X-Ray Flares:
There are currently eight sunspot regions on the visible disc. AR3256 remains the largest and most magnetically complex region on the disc. This has been the source of several C-class flares in the past 24 hours, the largest being a C4.6 flare at 27/0636 UTC. All of the other active regions appear stable and magnetically simple, with only minor fluctuations in areal extent.
Solar activity has been Low over the past 24 hours, with occasional minor C-Class flares. There remains a Chance of M-class flares, most likely from AR3256.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES X-Ray Flux



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16 is currently at Background levels. Proton flux is most likely to remain at Background levels, but with a Slight Chance of reaching S1 or greater should any larger flares or significant CMEs occur.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is now at High levels. There is considered a reasonably strong potential for further day-on-day increases in flux during days 1 to 2 (28th and 29th), possibly extending into day 3 (30th) of the four-day forecast period, with the 1000pfu High threshold now Expected to be breached at diurnal maximum each day in the expected absence of further significant geomagnetic activity.

Active 24-hour integrated electron fluence perhaps carries a Chance of being realised on day 1 (27th March). It is Expected that Active fluence levels will be reached on day 1 and 2 (28th and 29th March), perhaps into day 3 (30th), this reduces to a Chance by day 4 (31st).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	90	80	60	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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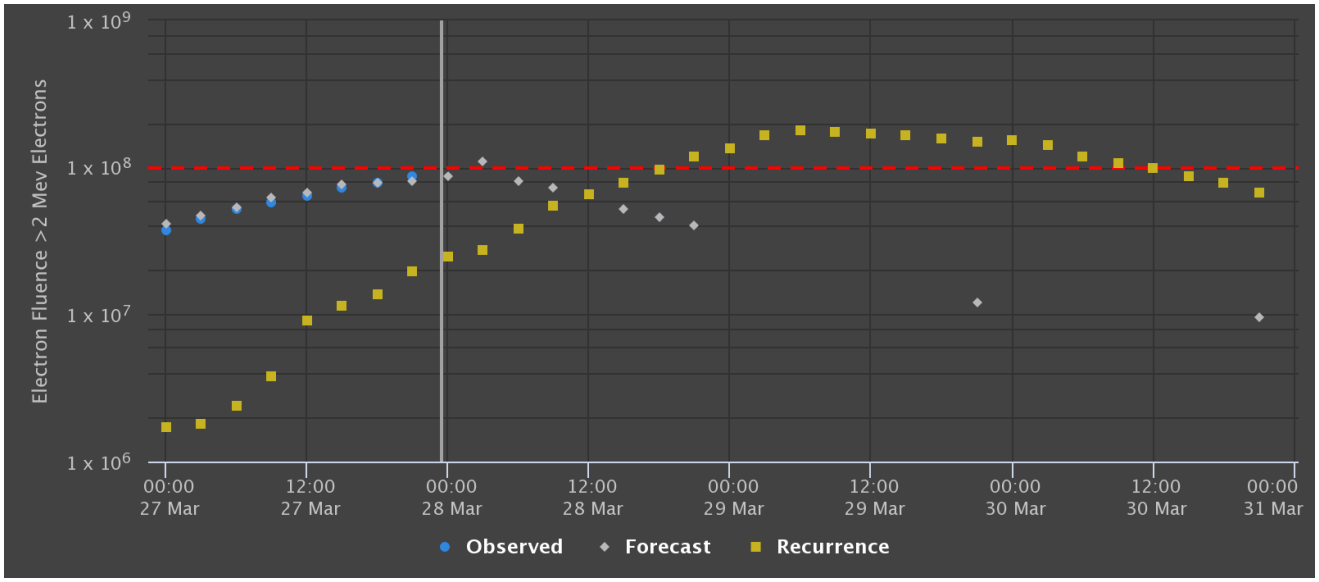
Figure 4: MOSWOC Electron Fluence – observations, forecast and recurrence



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